

What is claimed is:

1 A passenger accommodation unit for a vehicle, particularly an aircraft, which is adapted to provide self-contained, individual seating and sleeping accommodation for a passenger, said seat assembly comprising: supporting structure for supporting said unit off
5 the floor of a vehicle; one or more movable passenger-bearing, structural components; and means for connecting said movable, structural components to said structure such that said components can be selectively moved between a seat configuration, in which a plurality of passenger-bearing surfaces on said one or more structural, movable components or said supporting structure form a seat for the passenger, and a bed configuration, in which a
10 plurality of said bearing surfaces are disposed substantially coplanarly and substantially contiguously to form a bed for the passenger; wherein at least one of said movable components is double-sided, comprising first and second opposite sides, one of said sides having a first seat surface that forms part of the seat in said seat configuration, and the other side having a second bed surface that forms part of said bed in said bed
15 configuration, said at least one double-sided movable component being a back-rest component that is connected to said supporting structure such that it can be selectively pivoted between a first generally upright position, in which said first surface is arranged to form part of said seat, and a second prone position in which said second surface is arranged to form part of said bed, and wherein one or more of said passenger-bearing surfaces
20 comprise a bed extension surface, which bed extension surface is positioned or deployable to be positioned rearwardly of the seat to form part of said bed in said bed configuration.

2 A passenger accommodation unit as claimed in claim 1, wherein said one or more of said passenger-bearing surfaces comprise a rear extension surface behind said back-rest component, and wherein said back-rest component is connected to the structure such that
25 in said prone position said second bed surface and said rear extension surface are substantially coplanar.

3 A passenger accommodation unit as claimed in claim 2, wherein said back-rest component is spaced forwardly of said rear extension surface in said prone position and a movable infill component is provided that is connected to said structure such that it is
30 movable between a stowed position and a deployed position, which infill component comprises a passenger-bearing infill surface that extends between said back-rest component and said rear extension surface when said infill component is deployed, such that said rear extension surface, infill surface and second surface form a substantially continuous surface, and wherein means are provided for moving the infill component from

said stowed position to said deployed position when the back-rest component is moved from the upright position to the prone position.

4 A passenger accommodation unit as claimed in claim 1, wherein said second bed surface of said back-rest component is generally horizontal in said second prone position.

5 5 A passenger accommodation unit as claimed in claim 1, wherein one or more of said passenger-bearing surfaces comprise a seat-pan, and wherein said back-rest component is connected to the structure such that, in the second prone position, the back-rest component overlays the seat-pan.

10 6 A passenger accommodation unit as claimed in claim 5, wherein said seat-pan comprises one or more of said movable components which are connected to said structure for movement in a direction having a vertical component between an upper deployed position and a lower stowed position, and wherein seat-pan moving means are provided for moving the seat-pan from the upper deployed position to the lower stowed position when the back-rest component is moved from the upright position to the prone position.

15 7 A passenger accommodation unit as claimed in claim 1, wherein one or more of said passenger-bearing surfaces comprise a bed extension surface, which bed extension surface is positioned or deployable to be positioned forwardly of the seat in said seat configuration.

20 8 A passenger accommodation unit as claimed in claim 7, wherein said bed extension surface is positioned or is deployable to be positioned forwardly of the seat-pan component such that, in the seat configuration, said bed extension surface may serve as a foot-rest.

9 A passenger accommodation unit as claimed in claim 1, wherein said back-rest component is connected to the structure such that in said prone position said second bed surface and said bed extension surface form a substantially continuous surface.

25 10 A passenger accommodation unit as claimed in claim 1, wherein said back-rest component is connected to the structure for selective movement between an upright position and a fully reclined position in which the back-rest component is pivoted rearwardly relative to the upright position.

30 11 A passenger accommodation unit as claimed in claim 10, wherein one or more of said movable components comprise a seat pan which is connected to the supporting structure such that it can be pivoted relative to the back-rest component between a first position and a second position, and wherein means are provided for pivoting the seat pan progressively from the first position to the second position as the back-rest component is pivoted rearwardly from the upright position to the fully reclined position.

12 A passenger accommodation unit as claimed in claim 1, wherein said one side of the double-sided movable component carries layer of foam padding having a contoured surface that is shaped for use as a seat component and said other side carries a layer of foam padding having a substantially flat surface for use as part of a bed.

5 13 A passenger seat assembly for a passenger vehicle, particularly an aircraft, which assembly is adapted to provide seating and sleeping accommodation for a passenger, said unit comprising:

supporting structure adapted for supporting the assembly off the floor of the vehicle;

10 a plurality of seat elements including a seat-pan element and a back-rest element, said back-rest element comprising first and second opposite sides, one of said sides having a first seat surface and the other side having a substantially flat second bed surface;

a seat movement mechanism adapted for connecting the seat elements to the supporting structure, said seat movement mechanism including a seat conversion sub-
15 mechanism adapted to allow and control movement of the seat elements such that the seat elements can be selectively moved between a seat configuration and a bed configuration; and

one or more auxiliary accommodation elements connected to or forming part of said supporting structure and being positioned or being deployable to be positioned
20 juxtaposed said seat, the or each auxiliary accommodation element having an auxiliary, substantially flat, passenger-bearing surface;

said seat conversion sub-mechanism being adapted for controlling movement of the back-rest element such that said back-rest element is pivotable from a first upright position in the seat configuration, in which said first seat surface of the back-rest element
25 cooperates with said seat-pan element to form a seat for the passenger, to a second prone position in the bed configuration, in which the second bed surface of the back-rest element cooperates with one or more of said auxiliary passenger-bearing surfaces to form a substantially coplanar, continuous extended bed surface for the passenger, one or more of said auxiliary accommodation elements forming the extended bed surface being positioned
30 or being deployable to be positioned rearwardly of the seat.

14 A passenger seat assembly as claimed in claim 13, wherein said seat movement mechanism is adapted to control movement of said seat-pan element and said back-rest element in relation to each other.

15 A passenger seat assembly as claimed in claim 13, wherein said seat conversion
sub-mechanism is adapted to control movement of said back-rest element such that as the
back-rest element is moved from the first position to the second position said back-rest
element pivots forwardly over the seat-pan element, and said back-rest element in the
5 second prone position is superposed over the seat-pan element.

16 A passenger seat assembly as claimed in claim 15, wherein said seat conversion
sub-mechanism is adapted to control movement of the seat-pan element such that as the
back-rest element is moved from the first upright position to the second prone position said
seat-pan element is caused to move downwardly relative to the supporting structure.

10 17 A passenger seat assembly as claimed in claim 13, wherein said seat movement
mechanism further comprises a seat reclining sub-mechanism which is adapted to allow
said seat to be selectively reclined from an upright position to a fully reclined position, said
seat reclining mechanism being adapted to control movement of the back-rest element such
that as the seat is reclined from the upright position to the fully reclined position, said
15 back-rest element is rocked rearwardly from the first upright position to a third fully
reclined position.

18 A passenger seat assembly as claimed in claim 17, wherein said seat reclining sub-
mechanism is adapted to control movement of said seat-pan element such that as the back-
rest element is rocked rearwardly from the first upright position to the third fully reclined
20 position said seat-pan element is caused to tilt rearwardly.

19 A passenger seat assembly as claimed in claims 13, wherein one or more of said
auxiliary elements are positioned or deployable to be positioned forwardly of the seat.

20 A passenger seat assembly as claimed in claim 19, wherein one or more of said
auxiliary accommodation elements comprise a foot-rest positioned or deployable to be
25 positioned forwardly of said seat, and wherein in said second position the second bed
surface of the back-rest element is disposed substantially coplanarly and contiguously with
said foot-rest.

21 A passenger seat assembly as claimed in claim 13, wherein one or more of said
auxiliary elements comprise a fixed, rear extension surface positioned rearwardly of the
30 seat.

22 A passenger seat assembly as claimed in claim 21, wherein said seat comprises a
movable infill element and said seat conversion sub-mechanism is adapted to allow
movement of said infill component between a lower, stowed position and a raised,
deployed position in which said infill element extends substantially coplanarly and

contiguously with said second surface of said back-rest element in said second prone position and said rear extension surface, thereby to form a substantially flat, extended bed surface, and wherein said seat conversion sub-mechanism is further adapted to control movement of said infill component such that said infill component is caused to moved
5 from said stowed position to said deployed position when the back-rest element is moved from said first upright position to said second prone position.

23 A passenger seat assembly as claimed in claim 13, wherein said one side of the back-rest component carries a layer of foam padding having a contoured first surface that is adapted to form a back-rest or part of a back-rest of a seat and the other side carries a
10 layer of foam padding having a substantially flat second surface that is adapted to form part of a bed.

24 A passenger seat assembly as claimed in claim 13, wherein said seat conversion sub-mechanism comprises a seat holding device that is pivotably connected to said supporting structure for rocking movement between a first seat position and a second bed
15 position, said back-rest element being mounted on said holding device such that said back-rest element can be pivoted from said first upright position to said second prone position by rocking said holding device from said first position to said second position, and releasable locking means adapted for selectively locking said holding device in said first and second positions.

20 25 A passenger seat assembly as claimed in claim 24, wherein said seat-pan element is pivotably mounted on said holding device, the arrangement being such that when said holding device is rocked from the first position to the second position the seat-pan element is caused to move downwardly from an upper deployed position to a lower stowed position and the back-rest element rocks forwardly over the seat-pan element such that in said
25 second prone position the back-rest element overlays the seat-pan element.

26 A passenger seat assembly as claimed in claim 25, wherein said seat-pan element comprises a front end and a rear end relative to said back-rest element, said seat-pan element being pivoted to the holding device at or towards said rear end, and wherein said seat movement mechanism further comprises a seat-pan supporting device for supporting
30 the front end of the seat-pan element.

27 A passenger seat assembly as claimed in claim 26, wherein said seat-pan supporting device comprises a slideway disposed beneath said seat-pan element, a leg member having two opposing ends, one of said ends being pivotably connected to the front end of the seat-pan element, the other end being slidably engaged in said slideway, and a

drag-strut connecting said other end of the leg member to the holding device; the arrangement being such that as the holding device is rocked from the first position to the second position, the drag-strut is moved to cause or allow said other end of the leg member to slide in said slideway, the slideway having a profile such that as the holding device
5 moves from the first position to the second position, the leg-member is moved downwardly, thereby causing or allowing the front end of the seat-pan element to move progressively downwardly.

28 A passenger seat assembly as claimed in claim 24, wherein said seat movement mechanism further comprises a seat reclining sub-mechanism adapted to allow said seat
10 elements to be selectively moved between an upright position and a fully reclined position, when said holding device is disposed in said first seat position.

29 A passenger seat assembly as claimed in claim 28, wherein said seat reclining sub-mechanism comprises a curvilinear track attached to the holding device and having two
15 opposing track-ends and a plurality of spaced track-followers attached to said back-rest element, said track-followers being adapted to engage in and slide along said track, the track being configured such that as the track-followers slide along the track from one end to the other the back-rest element is caused to rock progressively rearwardly from the first upright position to a third fully reclined position.

30 A passenger seat assembly as claimed in claim 29, wherein said seat reclining sub-mechanism further comprises selectively operable, bi-directional driving device for
20 translationally moving said back-rest element relative to the holding device, the arrangement being such that operation of said driving means device said track-followers to slide along said curvilinear track, thereby causing the back-rest element to rock progressively between said first and third positions.

25 31 A passenger seat assembly as claimed in claim 30, wherein said driving device comprises a linear actuator connected between said back-rest element and said holding device.

32 A passenger seat assembly as claimed in claim 31, wherein said linear actuator comprises a linear screw fixedly secured to said holding device, a screw-engaging device
30 pivotably connected to said back-rest element and a selectively operable, bi-directional motor carried by said holding device for rotatably driving said linear screw.

33 A passenger seat assembly as claimed in claim 31, wherein said seat-pan element has a front end and a rear end relative to said back-rest element and said linear actuator is pivotably connected between said holding device and said seat-pan element, said linear

actuator being attached to the seat-pan element at or towards said rear end, for driving said seat-pan element progressively downwards relative to the supporting structure from a first upper position when said back-rest element is in said first upright position to a second lower position when said back-rest element is in said third fully reclined position, and
 5 wherein seat movement mechanism further comprises a seat-pan supporting device for supporting the front end of the seat-pan element as the rear end of the seat-pan element is driven downwardly, thereby causing the seat-pan to tilt progressively rearwardly as the back-rest element rocks rearwardly.

34 A passenger seat assembly as claimed in claim 31, wherein said linear actuator is
 10 connected to said back-rest element through a lost motion device to allow a small degree of relative translational movement between said seat-pan and back-rest elements.

35 A passenger seat assembly as claimed in claim 24, wherein said seat conversion sub-mechanism further comprises a selectively operable, bi-directional actuator for rocking said holding device between said first seat position and said second bed position.

15 36 A passenger seat assembly as claimed in claim 35, wherein said actuator comprises a four bar double-rocker linkage, said linkage comprising a rocker and a coupler link connected intermediate said holding device and said rocker, and selectively operable, bi-directional rotary drive device for operating said rocker, the arrangement being such that operation of said rocker causes rocking of said holding device between said first and
 20 second positions.

37 A passenger seat assembly as claimed in claim 36, wherein said rotary drive device comprises a motor, a worm-gear and a worm-wheel, wherein said worm wheel is fixedly secured to said rocker.

38 A passenger seat assembly as claimed in claim 37, wherein said worm-gear is
 25 disengageable from said worm-wheel to allow said holding device to be rocked manually between said first and second positions.

39 A passenger seat assembly as claimed in claim 35, wherein said actuator is attached to the supporting structure beneath said seat elements.

40 A passenger seat assembly as claimed in claim 24, wherein said holding device
 30 comprises two spaced side members disposed respectively to opposing sides of said back-rest element.

41 A passenger seat assembly as claimed in claim 40, wherein said coupler link is connected to said side members below the pivot between the holding device and the supporting structure.

42 A passenger seat assembly as claimed in claim 37, wherein in the first position the rocker and coupler link subtend an angle of 180° to form a strut, whereby forces applied to the holding device are transmitted lineally through the rocker, and are not transmitted rotationally to the worm-screw.

5 43 A passenger seat assembly as claimed in claim 38, wherein said worm-gear is coupled to said worm-wheel through a break-link device which is adapted to prevent inadvertent disengagement of the worm-gear from the worm-wheel, but can be selectively operated to allow the worm-gear to be disengaged from the worm-wheel.

10 44 A seating system for a passenger vehicle, particularly an aircraft, comprising a plurality of seat units, each seat unit defining a notional longitudinal seat axis and comprising a supporting structure adapted for attaching the seat unit to a floor of a vehicle and elements forming or being selectively configurable for forming a seat, said seat comprising a seat-pan and a back-rest, and a substantially flat bed; wherein said seat units are arranged to form a column defining a notional longitudinal column axis, in which
15 column said seat-units are arranged side-by-side in a longitudinally offset relation at an acute angle to a notional column axis, thereby defining a space to the rear of each seat, and a major proportion of the bed of each seat unit is disposed forwardly of the position of the seat, which bed extends rearwardly into said space to extend the flat-bed.

20 45 A seating system as claimed in claim 44, wherein each seat unit includes a passenger supporting element in said space to the rear of the seat, which passenger supporting element forms part of said flat bed.

46 A seating system as claimed in claim 44, wherein said acute angle is in the range $30^\circ - 60^\circ$, preferably $40^\circ - 50^\circ$, e.g. 45° .

25 47 A seating system as claimed in claim 44, wherein said vehicle comprises an accommodation cabin, which cabin defines a notional longitudinal cabin axis, and wherein said notional column axis is substantially parallel to or subtends an acute angle with said cabin axis.

30 48 A seating system as claimed in claim 44, wherein said seat units are disposed adjacent a side wall of the vehicle and face inwardly, or are disposed back-to-back with the seat units in another column.

49 A seating system as claimed in claim 44, wherein each seat unit further comprises a foot-rest that is positioned forwardly of the seat.

50 A seating system as claimed in claim 49, wherein each seat unit further comprises a first privacy screen that is positioned forwardly of said foot-rest.

51 A seating system as claimed in claim 44, wherein said elements comprise one or
more movable passenger-bearing elements which are selectively configurable to form, in a
seat mode, at least part of the seat for a passenger or, in a bed mode, at least part of said
flat bed, and wherein the flat bed in the bed mode is disposed at substantially the same
5 level as the seat-pan in the seat mode.

52 A seating system as claimed in claim 51, wherein each seat unit comprises a first
passenger-supporting element in said space to the rear of the seat, which first passenger-
supporting element is disposed substantially coplanarly with said one or more movable
elements when said movable elements are configured in the bed mode and is adapted to
10 form part of said flat bed.

53 A seating system as claimed in claim 51, wherein each seat unit further comprises a
second passenger-supporting element to one side of each seat, which second passenger-
supporting element is disposed substantially coplanarly with said first passenger supporting
element and is adapted to form part of said flat bed when the movable elements are
15 configured in said bed mode, thereby to extend said flat bed laterally.

54 A seating system as claimed in claim 53, wherein the first fixed element of one seat
unit is disposed substantially contiguously to the second fixed element of an adjacent seat
unit, said first and second elements being divided from one another by a second privacy
screen.

20 55 A recliner seat assembly, particularly for use on a vehicle such, for example, as an
aircraft, comprising a fixed supporting portion adapted for supporting the assembly off a
floor of the vehicle, a reclinable seat portion comprising a seat-pan and a back-rest, and a
seat connecting device adapted for connecting said seat portion to said supporting portion,
said connecting device including a seat reclining mechanism adapted for allowing and
25 controlling translational movement of said seat portion relative to the supporting portion
between a first upright position and a second fully reclined position and a selectively
operable, bi-directional motor adapted for driving said seat portion between said first and
second positions; wherein said seat reclining mechanism comprises a guiding device for
rocking said back-rest progressively rearwardly relative to the supporting portion as the
30 seat portion is moved from the first upright position to the second fully reclined position,
and said motor is connected to the seat portion by a non-reversible linear actuator.

56 A recliner seat assembly as claimed in claim 55, wherein said non-reversible linear
actuator comprises a lead screw drive or ball screw drive.

57 A recliner seat assembly as claimed in claim 55, wherein said linear actuator comprises a linear screw or ball screw attached to said one of said supporting portion (or a part connected thereto) and said seat portion and a screw-engaging device attached to the other of said seat portion and said supporting portion (or a part connected thereto).

5 58 A recliner seat assembly as claimed in claim 55, wherein said linear actuator is connected to said seat-pan for driving said seat-pan along a predetermined linear path between a first position and a second position relative to said supporting portion.

59 A recliner seat assembly as claimed in claim 58, wherein said seat-pan has a front end and a rear end relative to the back-rest and said linear actuator is pivotably connected to said seat-pan at or towards said rear end and is arranged for driving said rear end of the seat-pan downwardly as it moves from the first position to the second position, and wherein said seat reclining mechanism further comprises a supporting device for supporting the front end of the seat-pan as the rear end of the seat-pan is driven downwardly, thereby causing the seat-pan to tilt rearwardly as the back-rest rocks rearwardly.

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60 A recliner seat assembly as claimed in claim 55, wherein said guiding device comprises a curvilinear track attached to the supporting portion or a part connected thereto and a plurality of spaced track-followers attached to said back-rest, said track-followers being adapted to engage in and slide along said track.

20 61 A recliner seat assembly as claimed in claim 55, wherein said linear actuator is pivotably connected to said seat-pan and is pivotably connected to said back-rest through a lost-motion device to allow relative pivoting and translational movement between said seat-pan and back-rest.

62 A seat having a reclinable back-rest, said seat comprising a fixed supporting portion adapted for supporting the seat off a floor, a seat portion comprising a reclinable back-rest and a seat connecting device adapted for connecting said seat portion to said supporting portion, said connecting device including a back-rest reclining mechanism adapted for allowing and controlling movement of said back-rest between a first upright position and a second fully reclined position; wherein said back-rest comprises a first lower back-rest member having an upper end and a second upper back-rest member that is superposed said first back-rest member and is pivotably connected at or towards the upper end thereof so as to transmit translational movement therebetween, and wherein said back-rest reclining mechanism comprises first and second elongate guide tracks attached to the supporting portion or a part connected thereto, said first track having two opposing track-

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ends, a plurality of first spaced track-engaging follower members attached to the first back-rest member adapted to engage and slide in one of said tracks and a second track-engaging follower member attached to the second back-rest member or a part connected thereto, said first track being curvilinear such that as the first track-engaging follower members slide
 5 along said first track from one end to the other the first back-rest member is caused to rock progressively relative to the supporting portion between the first upright position and the second fully reclined position, and said second track having a profile such that as said second track-engaging follower member is caused to slide along the second track, the second back-rest member is caused to rock progressively with respect to the first back-rest
 10 member.

63 A seat having a reclinable back-rest as claimed in claim 62, wherein said back-rest reclining mechanism comprises a rocker lever having two arms which subtend an obtuse angle, which rocker is pivoted to said first back-rest member at a point intermediate said two arms, one of said arms carrying said second track-engaging follower member, and a
 15 connecting lever having two opposite ends, one of said ends being pivoted to the other arm of said rocker and the other end being fixedly secured to the second back-rest member; the arrangement being such that as the second follower member is caused to slide along said second track, the rocker is caused to rock about its pivot to the first back-rest member, causing said lever to pivot about its pivot to the other arm of the rocker, thereby causing
 20 the second back-rest member to rock about its pivot to the first back-rest member.

64 A seat having a reclinable back-rest as claimed in claim 62, wherein said seat connecting device further comprises a selectively operable, bi-directional linear actuator connected between said supporting portion or a part connected thereto and said back-rest for moving said back-rest translationally relative to said supporting portion, the
 25 arrangement being such that as the back-rest is caused to move translationally relative to the supporting portion the first follower members on said first back-rest member are caused to slide progressively along said first track, thereby causing said back-rest to rock progressively between said first upright and second fully reclined positions.

65 A seat having a reclinable back-rest as claimed in claim 64, wherein said seat
 30 portion comprises a seat-pan and said linear actuator is connected to said seat-pan for moving said seat-pan along a predetermined linear path between a first position and second position.

66 A seat having a reclinable back-rest as claimed in claim 65, wherein said linear actuator is pivotably coupled to said seat-pan.

67 A seat having a reclinable back-rest as claimed in claim 64, wherein said linear actuator is pivotably coupled to said back-rest by a lost motion device.

68 A seat module for a passenger vehicle, said seat module comprising a seat portion,
a foot-rest portion, a unitary supporting structure for supporting said seat portion and said
5 foot-rest portion off the floor of the vehicle, two spaced fixings for fixing the supporting structure to one of a pair of seat tracks in a floor of the vehicle at two spaced points, and a third fixing for fixing the supporting structure to the other track, thereby to provide a 3-point fixing between the seat module and the seat tracks for attaching said supporting structure to said pair of seat tracks; whereby a plurality of said seat modules can be
10 attached to a pair of seat tracks, one adjacent another, thereby to form a plurality of seat units, each seat unit comprising the seat portion of one module and the foot-rest portion of another, adjacent module.